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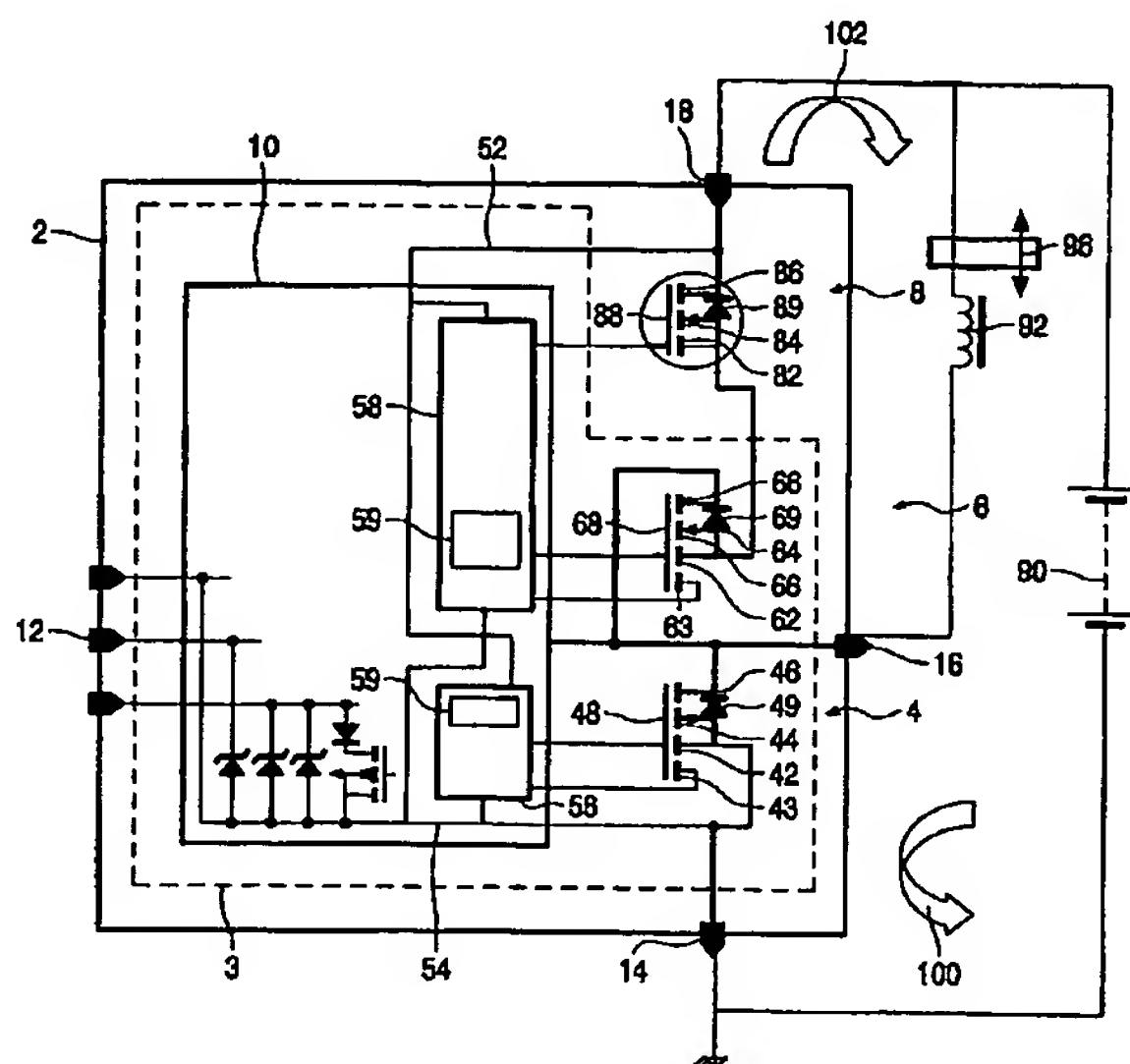
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[Continued on next page]

(54) Title: DRIVER FOR INDUCTIVE LOAD



(57) Abstract: A driver for an inductive load such as a solenoid coil 92 includes three FETs 4,6,8. Two of the FETs are reversely connected between battery and output terminals 16, 18, and one of the FETs is connected between output and ground terminals 16, 14. A driver circuit 10 having high and low side control circuitry 58,56 is formed in a common substrate with two of the FETs 4,6. In use, a coil 92 is connected to the output terminal 16, and driven in an energise mode in which current in the coil 92 is built up as indicated by arrow 100, a freewheel mode in which current circulates freely as indicated by arrow 102, and then may be switched off. The reversely connected FETs allow both short circuits to be prevented in the energise mode and allow the coil to be rapidly switched off. In spite of the control circuitry being formed in a common substrate with some of the FETs, the arrangement allows the FETs to be properly driven.



TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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**Declaration under Rule 4.17:**

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations* AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT,

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*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

# INTERNATIONAL SEARCH REPORT

International Application No

PC 17 IB2004/001157

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H03K17/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H03K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, INSPEC

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 100 50 287 A (CONTI TEMIC MICROELECTRONIC) 8 May 2002 (2002-05-08) column 2, line 40 - line 41 column 3, line 6 - line 14; figures 2,3 column 3, line 28 - line 36 column 3, line 42 - line 65 column 3, line 66 - column 4, line 3	1,2, 11-13
A	US 5 012 381 A (GAUEN KIM R ET AL) 30 April 1991 (1991-04-30)	1,4,11
X	abstract; figures 2-4 column 2, line 1 - line 13 column 2, line 51 - line 68	12,13
-/--		



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

\* Special categories of cited documents :

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \* & \* document member of the same patent family

Date of the actual completion of the International search

5 October 2004

Date of mailing of the International search report

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## INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB2004/001157

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 508 906 A (NELLI CHRISTOPHER J ET AL) 16 April 1996 (1996-04-16) abstract; figures 3,4 column 3, line 50 - column 4, line 4 column 4, line 24 - line 32 column 1, line 6 - line 8 column 1, line 12 - line 23 -----	1,5,8,9, 11-14
A	DE 197 32 094 A (BOSCH GMBH ROBERT) 28 January 1999 (1999-01-28) figure 1 -----	1
A	PHILIPS SEMICONDUCTORS: "AN01048- PIP3 TOPFETs for industrial automation" APPLICATION NOTE, 12 December 2001 (2001-12-12), pages 1-12, XP002299228 THE NETHERLANDS cited in the application figure 3 page 6, paragraph 7.1 page 11, right-hand column -----	1,7,11

## FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 10

It is not clear what is meant by common substrate of the high and low side driver in view of the description and figure 1 since the sources of the high side FET and low side FET are not connected together. Accordingly the lines starting with "high and low side driver ..." under the end of the claim are not clear at all, since the voltage on the common substrate can not be understood from the description for the reason explained above.

The search would only be possible to the clear feature of claim 10 as can be found in the first five lines. These features are known from documents DE10050287A, US5012381A, US5508906A, DE19732094A.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.5), should the problems which led to the Article 17(2) declaration be overcome.

# INTERNATIONAL SEARCH REPORT

national application No.  
PCT/IB2004/001157

## Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 10  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:  
see FURTHER INFORMATION sheet PCT/ISA/210
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this International application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PC., IB2004/001157

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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			JP 7067810 A	14-03-1995
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